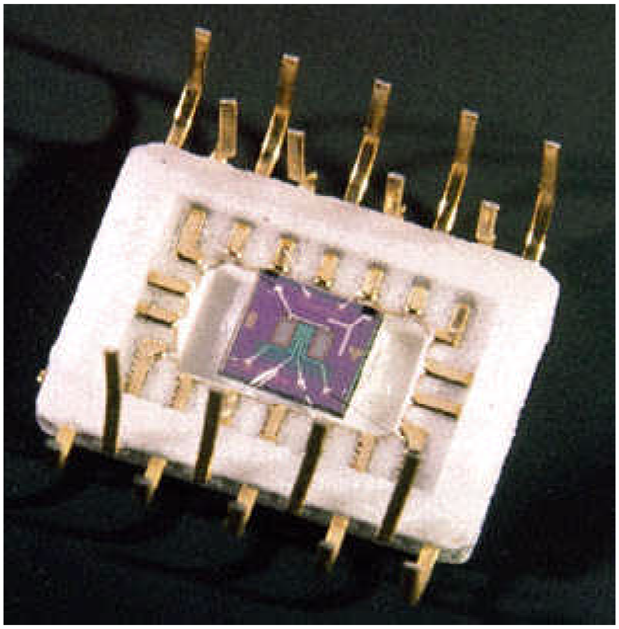
Hydrogen Sensors Demonstrated on the Shuttle



Microfabricated hydrogen sensor.

Microelectromechanical-systems- (MEMS-) based hydrogen sensor technology developed by the NASA Glenn Research Center at Lewis Field and Case Western Reserve University was demonstrated on shuttle missions STS–95 (Senator Glenn's mission) and STS–96. These smart sensors, commercialized by Makel Engineering Inc., were part of an "Integrated Vehicle Health Monitoring HEDS Technology Demonstration" series conducted at the NASA Kennedy Space Center. The experiments were designed to demonstrate the effect of technological upgrades on shuttle performance.

The hydrogen sensors were microfabricated for minimal size, weight, and power consumption. A temperature detector and heater were included on the sensor for temperature control. Two palladium chrome (PdCr) hydrogen detection devices were included in each sensor package: a Schottky diode for low concentrations and a resistor for high concentrations. These sensor designs allow operation in inert environments. "Smart" electronics developed by Makel Engineering were integrated with the sensors to control the sensor temperature and process the output of the various sensors.

This complete hydrogen detection system (two sensors on a chip with smart electronics) flew on STS–95 (launched October 1998) and STS–96 (launched May 1999). It was installed in the aft compartment of the shuttle and used to monitor the hydrogen concentration in that region.

Up to this time, a mass spectrometer had monitored the hydrogen concentration in the aft compartment before launch, and "grab" bottles had been used after launch. The inside of these bottles is at vacuum. During flight, the grab bottles are pyrotechnically opened for a brief period, and the gas in the aft compartment is captured in the bottle. Several of these bottles are opened at different times during takeoff, and their contents are used to determine the time profile of the gases in the aft chamber. However, this information is not available until after the flight.

On the launch pad, results from the new sensor technology paralleled the responses of the mass spectrometer with, in some cases, a quicker response time. In flight, data from the new sensors agreed with those derived from analyzing the contents of the grab bottles. Moreover, this microsensor can monitor the aft compartment continuously and, in principle, could monitor the health of the vehicle in real time during flight.

Find out more about this research http://www.grc.nasa.gov/WWW/chemsensors/.

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